Synthetic Theater of WAR (STOW 97) Distributed Exercise Manager (DEM) Lessons Learned

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DEM Objectives for STOW 97 (1 of 2)

- **High Level Architecture (HLA) Exercise Control**
  - Communicated Directly with the RTI Providing Federation Create, Destroy, Pause and Resume
- **Run Time Infrastructure (RTI) Monitoring**
  - Monitored RTI MOM Data Channels
- **Network Monitoring**
  - Used rstatd to Monitor Packets in/out, Errors in/out, Collisions on Each LAN Computer
 - Used ping to Monitor LAN to LAN Latency and SNMP for MCED Traps

DEM Objectives for STOW 97 (2 of 2)

- **CPU Load Monitoring**
  - Used rstatd to Monitor CPU Load, Paging, and Swap In/Out
  - Developed SAF Frame Rate to Monitor SAF CPU Load
- **Problem Reporting**
  - Alarms Reported to Local LAN (DEMvice) and JTASC (DEM Central)
- **Logging and Retrieval of Monitored Data**
  - Used Informix SQL for Logging and Queries
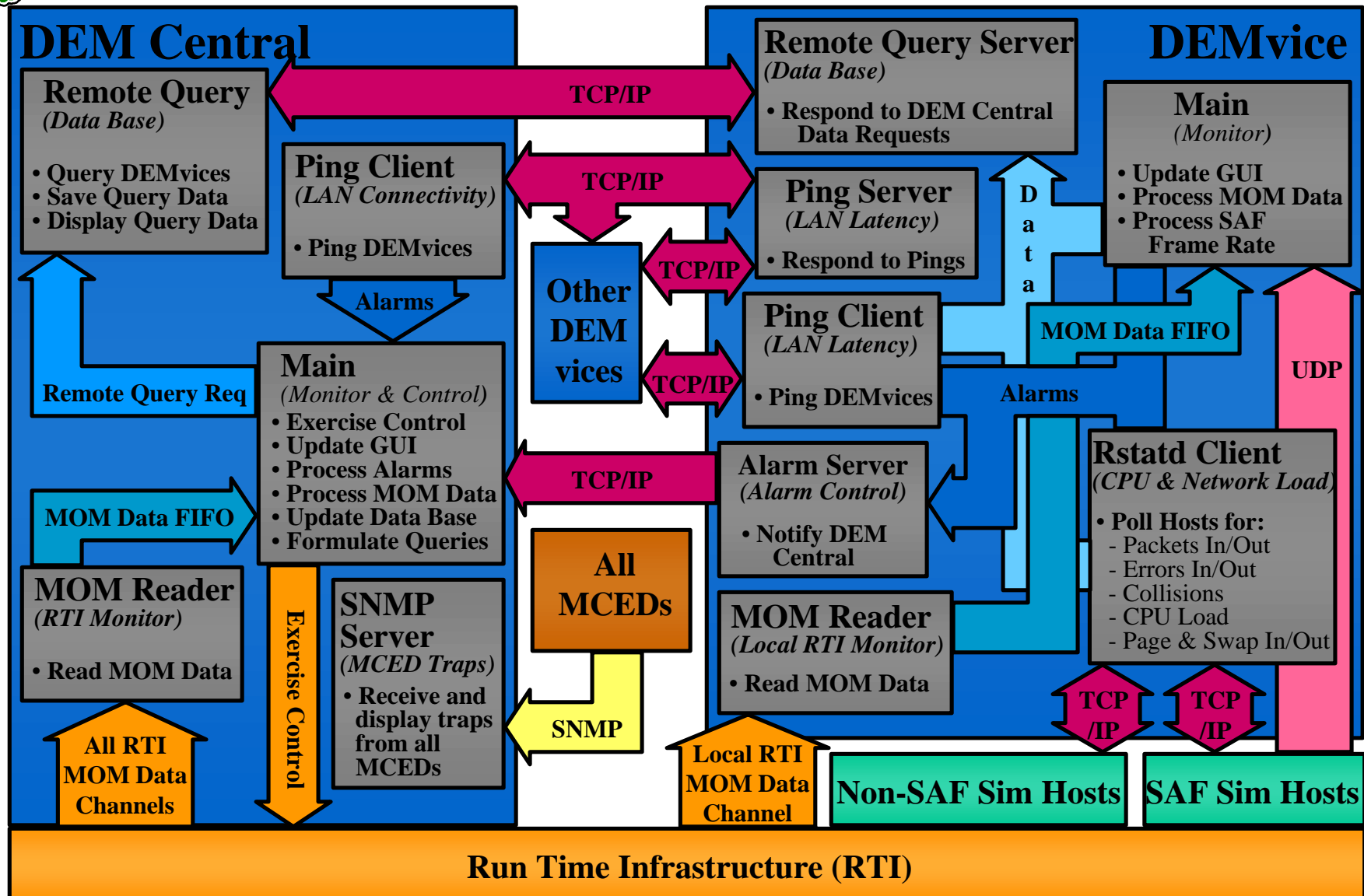
DEM STOW 97 ACTD Configuration

DEM Central (2)
JTASC

DEMvice
Lejeune

DEMvice
WISSARD

WAN

DEMvice
ARL
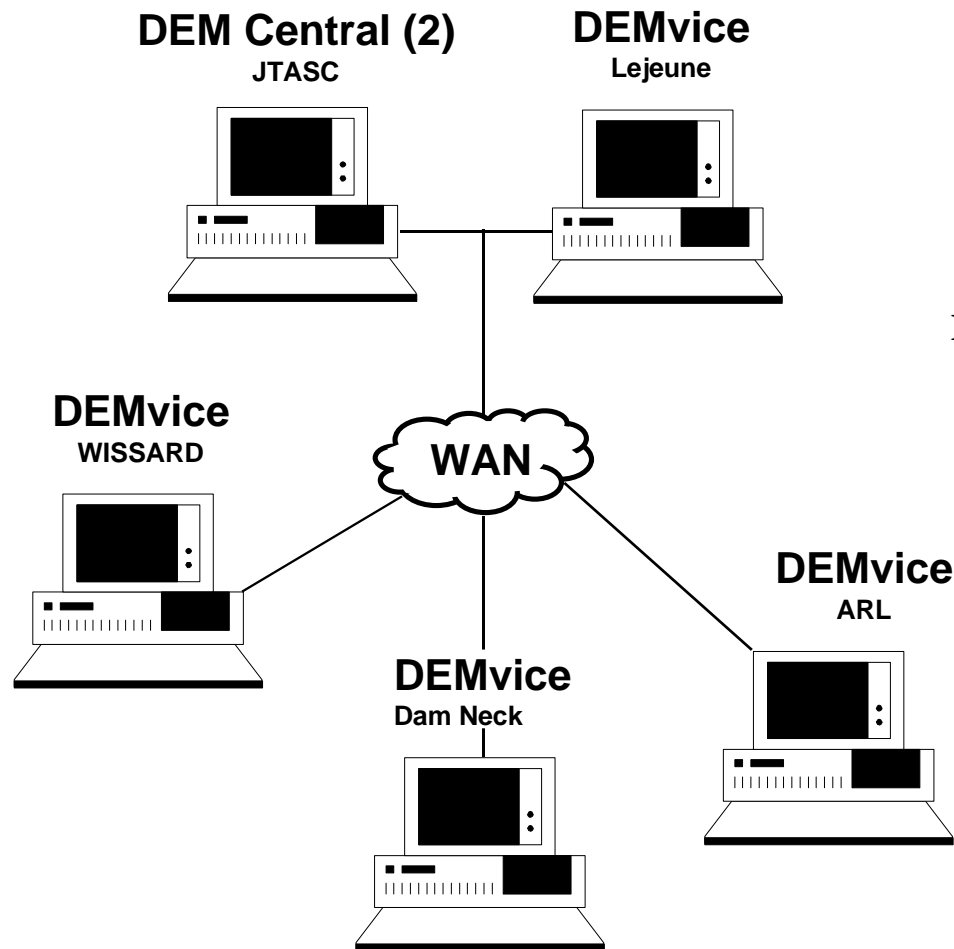
DEMvice
Dam Neck

DEM Central:
- **Located at JTASC**
- **Monitor all RTI MOM Channels**
- **Provide HLA Exercise Control**
- **Process alarms from DEMvices**
- **Log exercise statistics**
- **LAN-to-LAN connectivity**
- **Remote data base query capability**
- **Receive MCED SNMP traps**

DEMvices:
- **Located at each simulation LAN**
- **Network load monitoring:**
  - **Packets in/out, Errors in/out, Collisions**
- **Workstation monitoring:**
  - **CPU utilization, SAF frame rate**
- **LAN-to-LAN Latency**
- **Monitor local RTI MOM Channel**
- **Alarms for out-of-tolerance conditions**
- **Log local LAN statistics**
- **Forward alarms to DEM Central**
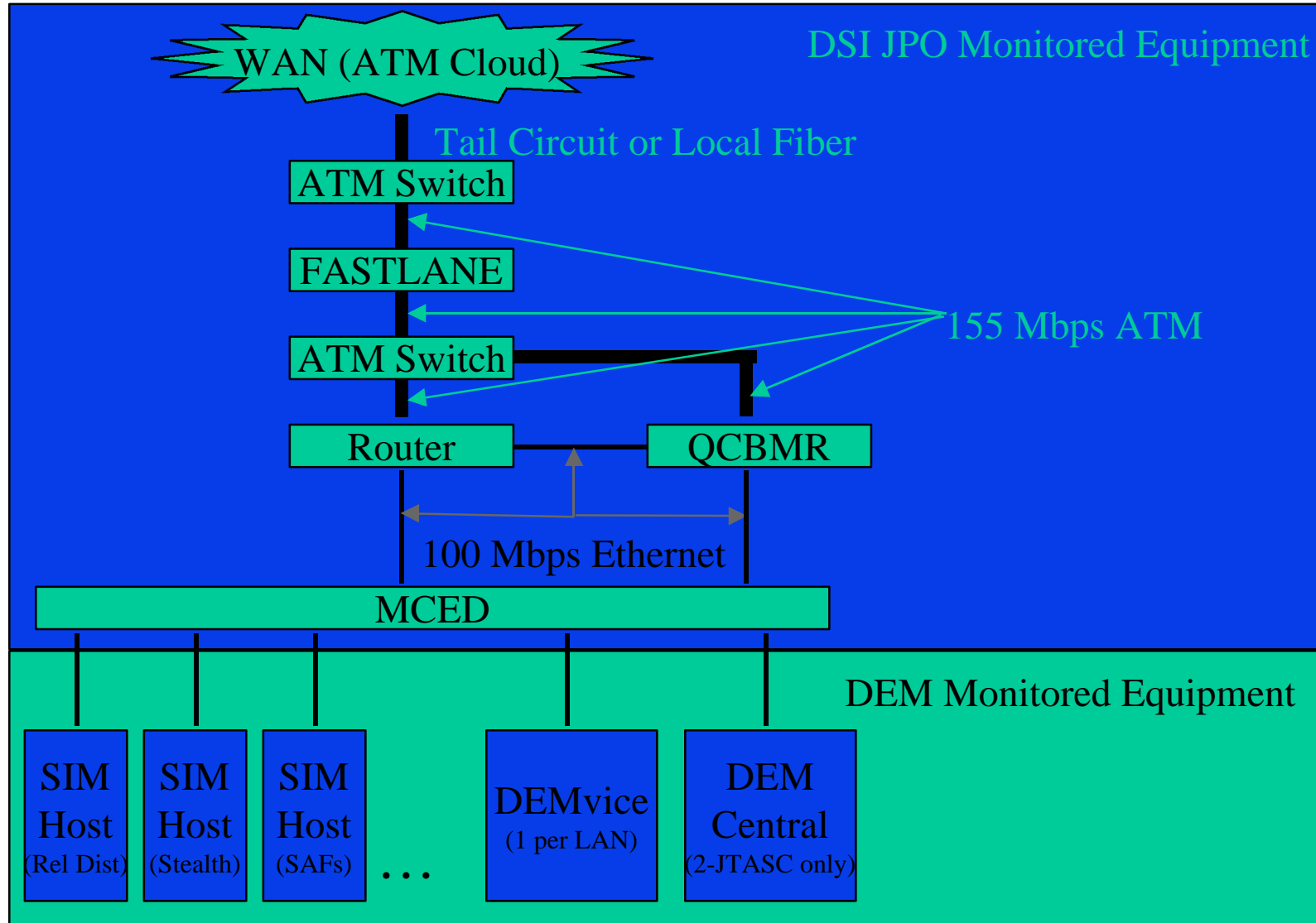- **Service DEM Central data requests**

DEM Architecture

DEM Central

Remote Query
(Data Base)

- Query DEMvices
- Save Query Data
- Display Query Data

Ping Client
(LAN Connectivity)

- Ping DEMvices

Alarms

Remote Query Req

Main
(Monitor & Control)
- Exercise Control
- Update GUI
- Process Alarms
- Process MOM Data
- Update Data Base
- Formulate Queries

MOM Data FIFO

MOM Reader
(RTI Monitor)

- Read MOM Data

Exercise Control

SNMP Server
(MCED Traps)

- Receive and display traps from all MCEDs

All RTI MOM Data Channels

Other DEM vices

All MCEDs

SNMP

TCP/IP

TCP/IP

TCP/IP

TCP/IP

TCP/IP

Remote Query Server
(Data Base)

- Respond to DEM Central Data Requests

Ping Server
(LAN Latency)

- Respond to Pings

Ping Client
(LAN Latency)

- Ping DEMvices

Alarm Server
(Alarm Control)

- Notify DEM Central

MOM Reader
(Local RTI Monitor)

- Read MOM Data

Local RTI MOM Data Channel

Data

Alarms

DEMvice

Main
(Monitor)

- Update GUI
- Process MOM Data
- Process SAF Frame Rate

MOM Data FIFO

UDP

Rstatd Client
(CPU & Network Load)

- Poll Hosts for:
  - Packets In/Out
  - Errors In/Out
  - Collisions
  - CPU Load
  - Page & Swap In/Out

TCP/IP   TCP/IP

Non-SAF Sim Hosts   **SAF Sim Hosts**

Run Time Infrastructure (RTI)

5

Typical STOW'97 ACTD Site Configuration

DSI JPO Monitored Equipment

WAN (ATM Cloud)

Tail Circuit or Local Fiber

ATM Switch

FASTLANE

155 Mbps ATM

ATM Switch

Router

QCBMR

100 Mbps Ethernet

MCED

DEM Monitored Equipment

SIM Host (Rel Dist)

SIM Host (Stealth)

SIM Host (SAFs)

...

DEMvice (1 per LAN)

DEM Central (2-JTASC only)

6

DEM Capabilities Used During ACTD

- **Hourly Data Samples were Taken**
  - Host Counts by Site
    - Hosts with/without Alarms
    - Hosts not responding
  - Entity Counts by Site
  - Object Counts by Type
  - Federate Counts by Type
  - Federate Subscription and Publication Counts
  - Network Latencies

DEM Capabilities Used During ACTD

- **Host-level data**
  - *SAF frame rates were monitored by most sites*
    - Provided overall indicator of SAF health
  - *Network traffic was used to debug specific problems (low frame rates, high site output, etc.)*
- **Network information**
  - *Connectivity and latency were monitored*
    - Provided the first indication that a site was experiencing problems

DEM Capabilities Used During ACTD

- **RTI MOM data**
  - *Entity count was the most requested piece of DEM data*
  - *Number of federates reporting was also important*
- **Real-time exercise information**
  - *When configuration file was up-to-date, DEM could identify BE/FE quickly, but this was only used occasionally*

DEM Capabilities Used During ACTD

- **Alarms were monitored**
  - *Many were false due to a mismatch between DEM config file and actual site host configuration*
  - *Others were uncorrectable (low SAF frame rates)??*
- **RTI exercise control capability was not used by the US but was used by the UK**

DEM Key Observations During ACTD

- **Maximum Entities Just over 3700 During ACTD**
  - *Lejeune (47%), ARL (30%), JTASC (19%), WISSARD (3%), Dam Neck (1%)*

- **Maximum of 300 Federates**
  - *Marine SAF (39%), Army SAF (19%), Air SAF (18%), Navy SAF (13%), ModSAF (6%), Non SAF (5%)*

- **Maximum Objects - Just under 8000**
  - *Entity State (47%), Transmitter (38%), Aggregate State (15%)*

DEM Key Observations During ACTD (cont)

- **Maximum of 365 Hosts Monitored**
  - *Highest percentage of alarm free workstations at Dam Neck*
    - Smallest # Computers (SGIs)
  - *Lowest percentage of alarm free workstations at WISSARD*
    - Changed Computers used a lot
- **Average Federate Publications to Multicast Groups was 4% of Subscriptions**
  - *Average Subscriptions (200), Average Publications (8)*

DEM Key Observations During ACTD (cont)

- **Site Host Averages (based upon total hosts at each site)**

	Alarm Free	Alarms	No Response
JTASC	73%	9%	18%
WISSARD	49%	8%	43%
DamNeck	74%	23%	3%
Lejeune	61%	30%	9%
ARL-UT	72%	15%	13%
Overall Average	65%	16%	19%

DEM Key Observations During ACTD (cont)

- LAN-to-LAN Latencies Averaged about 60ms Through both the Routers (Unicast) and QCBMRs (Multicast) as measured from ARL-UT to ALL other sites.

- LAN-to-LAN Latencies within the Norfolk area typically averaged 10ms.

DEM Lessons Learned/Recommendations

- **Human Factors**
  - *User interface needs improvement*
    - Quickly grew unwieldy when monitoring a large number of hosts
    - Need to provide capability to allow operator to view varying levels of detail easily

DEM Lessons Learned/Recommendations

- **Machine Configuration**
  - *Significant problem with machine configurations*
    - Last minute machine swapping at sites without notification, etc.
  - *Need Dynamic configuration capability*
    - relieve operators of the task of constantly updating config files and restarting the software.

DEM Lessons Learned/Recommendations

- Information Collection
  - *Must Have*
  - *Real-Time Analysis Too Slow*
  - *Review the data being collected*
    - Removing data that was not very useful (in/out errors)
    - Adding useful data (memory/swap utilization)
      - Believe most SAF crashes were due to running out of memory; by monitoring, may be able to predict crash before it happens

DEM Lessons Learned/Recommendations

- **Prioritization of Alarms**
  - *Some might simply be notifications (packets in too high) while others could be mild warnings (frame rate too low) or indication of a fatal condition (SAF not reporting).*

Summary

- **DEM achieved all objectives for STOW 97**

- **STOW 97 provided robust environment for DEM stress testing and evaluation**

- **Lessons learned from STOW will be incorporated in DEM Initial Operational Capability (IOC) scheduled for release in October 1998.**

- Improved GUI

  - Automated Configuration

  - Run-Time Query Capability.